

MU Guide

Fruit Spray Schedules for the Homeowner

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Fruit plantings can be a source of beauty as well as fresh produce. However, for the inexperienced grower, they also can be a source of frustration and expense. Nursery catalogs are full of brightly colored advertisements depicting bountiful harvests of unblemished fruit. Harvests like these are possible, but only with careful selection of the fruit cultivar (cultivated variety) and with diligent pest management. Weather conditions in Missouri, such as high humidity, abundant rainfall and warm temperatures, increase disease and insect populations. With few exceptions, home fruit plantings require treatment with pesticides to control a variety of serious diseases and insect pests. Pesticides needed and frequency of application depend on the cultivars planted, location of the planting, weather conditions and cultural practices.

How to use this guide

Table 1 is subdivided into pome fruits, stone fruits and small fruits. Within each section are listed the major developmental stages of the plants and the associated pests (insects and diseases) frequently occurring during each plant stage. These developmental plant stages are also referred to as "spray periods" when an application of a given pesticide is recommended in order to control a specific pest(s). Effective control of fruit insects and diseases depends on the proper timing of pesticide applications, and these spray periods indicate to the homeowner when certain sprays may be applied.

Note: Not all insects or diseases listed in each plant's developmental stage (or spray period) will be present in your fruit plantings. We have listed the most commonly encountered fruit insects and diseases in Missouri. For many pests, we have also provided brief descriptions of the damage they cause. The presence of the key symbol in the table indicates the most important sprays that should be applied against key pests or pest complexes.




We have tried to list only the pesticides readily available to the homeowner at most nursery and garden, hardware, and home improvement centers (Table 2). The pesticides are not listed in any particular order of effectiveness, although some products may be more effective against some types of pests than another product. *In many cases, one or two pesticides listed in a given spray period will be effective against all the pests listed for that time of the season.*

Several commercial fungicide/insecticide combinations are available for the homeowner. These may be more desirable for fruit growers not wanting to make their own combinations of pesticides that are recommended in this publication. Commercial home fruit spray mixtures are convenient to use but may not control all of the insects and diseases found on all fruit crops because each product usually contains only one type of insecticide and fungicide.









(Continued on page 13)

Table 1. Pesticides used to control common diseases and insect pests on home fruit plants.


Apples and pears

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAY			
Apply before buds swell. 	mites, scale	dormant oil	Oil smothers overwintering eggs of mites and scale. Apply oil when temperature is above 40° F. When European red mite infestations are high, the bright red eggs may be seen on the smaller branches and twigs.
	fire blight	Bordeaux mixture	Apply alone — may have compatibility problems with other pesticides. Best if applied at the "silver tip" (bud swelling) stage. Do not apply after the "half-inch green" stage or when drying conditions are slow — severe plant injury may occur. For more information on fire blight, see MU publication G6020.



Apples and pears (continued)

Spray period	Pest/Disease	Material	Comments
GREEN TIP TO HALF-INCH GREEN SPRAY			
<p>Apply when green leaves are 0.25–0.5 inch long.</p> 	mites, scale 	dormant or summer oil	Oil application delayed until this time may give even better control of scale than when applied earlier. Eggs of European red mite start to hatch at this time. Apply oil at temperatures above 40° F, and do not apply within 14 days before or after using sulfur or captan.
	leafminers	esfenvalerate <i>or</i> neem <i>or</i> spinosad	Newly developing mines appear as blotches only on the underside of the leaf, whereas completed mines buckle the leaf like a small tent (with white spots) and are visible on both the upper and lower leaf surfaces. Neem (azadirachtin) is a botanical insecticide. Spinosad is a naturally derived product from a species of bacteria.
	aphids	malathion <i>or</i> neem <i>or</i> insecticidal soap	For insecticidal soap repeat application 3-4 days later. Neem (azadirachtin) is a botanical insecticide.
	pear psylla	esfenvalerate <i>or</i> permethrin	Pear pest only — can secrete large amounts of honeydew that covers the fruit and foliage. The honeydew serves as a substratum for the growth of a black fungus. Do not make more than three permethrin sprays per season.
	primary scab 	captan <i>or</i> mancozeb <i>or</i> myclobutanil <i>or</i> sulfur <i>or</i> thiophanate-methyl	Do not apply captan with or immediately following an oil spray. Combining captan with Bordeaux mixture or lime sulfur will reduce effectiveness of captan. Combinations of captan and sulfur may cause necrotic spotting on leaves of susceptible varieties (e.g., Jonathan, MacIntosh). Captan is more effective on scab than sulfur.
PREBLOOM OR PINK SPRAY			
<p>Apply when blossom buds are clearly evident but not open.</p> 	plant bugs, stink bugs 	esfenvalerate <i>or</i> permethrin	Feeding injury results in aborted flowers and, later, in dimple-like scars on fruit. Do not make more than three permethrin sprays per season.
	aphids	malathion <i>or</i> endosulfan <i>or</i> neem <i>or</i> insecticidal soap	See comments in “green-tip to half-inch green” section.
	pear psylla	esfenvalerate <i>or</i> permethrin	See comments in “green-tip to half-inch green” section.
	primary scab	captan <i>or</i> mancozeb <i>or</i> myclobutanil <i>or</i> sulfur <i>or</i> thiophanate-methyl	See comments in “green-tip to half-inch green” section.
	rust 	mancozeb <i>or</i> myclobutanil <i>or</i> sulfur	MacIntosh, Golden Delicious, Jonathan, and certain other varieties may be injured by sulfur applications under certain conditions. Sulfur provides fair to poor rust control.
	powdery mildew	lime sulfur <i>or</i> myclobutanil <i>or</i> sulfur <i>or</i> thiophanate-methyl	Combinations of captan and sulfur may cause necrotic spotting on leaves of susceptible varieties.
BLOOM SPRAY			
<p>Apply when 25% of blossoms are open.</p> 			Do not use insecticides during this period — Save the bees!
	primary scab	captan <i>or</i> mancozeb <i>or</i> myclobutanil <i>or</i> sulfur <i>or</i> thiophanate-methyl	See comments in “green-tip to half-inch green” section.
	fire blight 	streptomycin	Apply at first bloom on susceptible varieties (see MU publication G6020). Repeat at 4–5 day intervals until the petal-fall stage.

Apples and pears (continued)

Spray period	Pest/Disease	Material	Comments
	rust	mancozeb or myclobutanil or sulfur	See comments in "prebloom or pink" section.
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	See comments in "prebloom or pink" section.
PETAL-FALL SPRAY			
Apply when most of blossom petals have fallen. 	plum curculio leafrollers	esfenvalerate or malathion or methoxychlor or permethrin or spinosad	Surface feeding and egg laying by overwintering adult plum curculio scar (crescent-shaped cuts) or misshape (bumps) the fruit by harvest. Internal feeding by larvae may cause some premature fruit drop. Peak egg hatch of redbanded leafroller usually coincides with petal fall. Some labels indicate no applications of permethrin after petal-fall. Spinosad for leafrollers only.
	plant bugs stink bugs	esfenvalerate or malathion or insecticidal soap or permethrin	See comments in "prebloom to pink" section. For insecticidal soap repeat application 3-4 days later. Some labels indicate no applications of permethrin after petal-fall.
	aphids	endosulfan or malathion or insecticidal soap or neem or permethrin or imidacloprid	Rosy apple aphid feeding often causes leaves to curl. See comments in "green-tip to half-inch green" section. Some labels indicate no applications of permethrin after petal-fall. One application of imidacloprid per year.
	leafminers	esfenvalerate or neem or permethrin or spinosad or imidacloprid	See comments in "green-tip to half-inch green" section. Some labels indicate no applications of permethrin after petal-fall. One application of imidacloprid per year.
	pear psylla	esfenvalerate or malathion	See comments in "green-tip to half-inch green" section.
	scab	captan or mancozeb or myclobutanil or sulfur or thiophanate-methyl	See comments in "green-tip to half-inch green" section.
	rust	mancozeb or myclobutanil or sulfur	See comments in "prebloom or pink" section.
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	See comments in "prebloom or pink" section.
EARLY-SEASON COVER SPRAYS			
Apply 10 days after petal-fall and at 10-day intervals through May.	codling moth leafrollers	carbaryl or esfenvalerate or malathion or methoxychlor or spinosad	These sprays are critical for first-generation codling moth control. Codling moth larvae damage apples and pears by burrowing to the core (usually from the apple side or calyx end) with brown frass (fecal material) exuding from the entry site. In Missouri, there are often three generations of codling moth per season. Leafroller damage consists of skeletonized leaves folded together by webbing or attached to fruit where the larvae feed on the fruit surface making shallow, irregular channels. Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning. Spinosad for leafrollers only.




Apples and pears *(continued)*

Spray period	Pest/Disease	Material	Comments
EARLY-SEASON COVER SPRAYS — CONTINUED	plum curculio	carbaryl or esfenvalerate or malathion or methoxychlor	See comments in “petal-fall” section. Emerging adults in the summer feed on apples for a short time, causing round feeding scars on the fruit surface. Severely infested fruit may be covered with bumps and scarred at harvest. Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.
	aphids	endosulfan or insecticidal soap or malathion or neem or imidacloprid	See comments in “petal-fall” section.
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	Discontinue sulfur use when temperatures reach 90° F.
	leafminers	carbaryl or esfenvalerate or neem or imidacloprid or spinosad	See comments in “green-tip” section. High populations can cause severe defoliation, leading to reduced fruit and terminal growth, early leaf drop, and reduced fruit set the following season. Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.
	mites	malathion or summer oil or insecticidal soap	Severe mite feeding results in brown foliage that eventually becomes bronzed (due to the removal of leaf cell contents, including chlorophyll). To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl, or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40° F and below 90° F. For insecticidal soap repeat application 2–3 days later.
	scale	carbaryl or summer oil or insecticidal soap or imidacloprid	Scale crawlers typically active at this time. Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning. To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl, or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40° F and below 90° F. For insecticidal soap repeat application 2–3 days later. One application of imidacloprid per year.
	pear psylla	carbaryl or esfenvalerate	See comments in “green-tip to half-inch green” section.
	scab	captan or myclobutanil or sulfur or thiophanate-methyl	See comments in “green-tip to half-inch green” section.
	rust	myclobutanil or sulfur	See comments in “prebloom or pink” section.
	fruit rots	captan or thiophanate-methyl	These fungicides may be combined for increased effectiveness.
SUMMER COVER SPRAYS			
Apply at 14-day intervals, June through mid-August.	codling moth leafrollers 	carbaryl or esfenvalerate or malathion or methoxychlor or spinosad	See comments in “early-season cover sprays” section. See Table 2 for days between last application and harvest.
	mites 	summer oil or malathion or insecticidal soap or pyrethrins and rotenone	See comments in “early-season cover spray” section. See Table 2 for days between last application and harvest.









Apples and pears (continued)

Spray period	Pest/Disease	Material	Comments
SUMMER COVER SPRAYS — CONTINUED	scale	summer oil or carbaryl or insecticidal soap	See comments in “early-season cover spray” section. On fruit the San Jose scale can be seen as a conspicuous red spot. Apply pesticide when crawlers are active. See Table 2 for days between last application and harvest.
	leafhoppers	carbaryl or esfenvaterate or methoxychlor or neem	Damaged foliage (upper leaf surface) becomes speckled or mottled with white spots. See Table 2 for days between last application and harvest.
	leafminers	carbaryl or esfenvaterate or neem or spinosad	See comments in “early-season cover spray” section. See Table 2 for days between last application and harvest.
	aphids	endosulfan or insecticidal soap or malathion or neem	See comments in “petal-fall spray” section. See Table 2 for days between last application and harvest.
	scab fruit rots sooty blotch fly speck	captan or thiophanate-methyl	These fungicides may be combined for increased effectiveness. See Table 2 for days between last application and harvest.


Peaches, nectarines, plums, apricots

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAY			
Apply before buds swell in spring.	mites, scale	dormant or summer oil	Oil smothers overwintering eggs of mites and scale. Apply oil at temperatures above 40° F and not within 14 days before or after using sulfur, or captan.
	peach leaf curl plum pockets 	Bordeaux mixture or chlorothalonil	For peach leaf curl, apply at leaf drop in late fall, and 1–2 additional applications in mid- to late winter before bud swell. For plum pockets, use of resistant plum cultivars is the preferred control measure. But for susceptible cultivars, apply chlorothalonil (or Bordeaux mixture, or liquid lime-sulfur) before bud swell.
PREBLOOM OR ‘POPCORN’ SPRAY			
Apply when buds show white, pink or red. 	plant bugs stink bugs	carbaryl or malathion or esfenvaterate or permethrin	Plant bugs and stink bugs feed on swelling fruit and leaf buds, causing the buds to dry up. When fruit buds are damaged, blossoms may never open or may be deformed. Use permethrin on peaches only.
	brown rot scab leaf spot	captan or chlorothalonil or myclobutanil or sulfur or thiophanate-methyl	For brown rot, use chlorothalonil, captan, myclobutanil or thiophanate-methyl.
BLOOM SPRAY			
Apply when 25% of blossoms are open. 	Do not use insecticides during the bloom period — Save the bees!		
	brown rot scab	chlorothalonil or captan or myclobutanil or sulfur or thiophanate-methyl	See comments in “prebloom” section.
	powdery mildew leaf spot	myclobutanil or sulfur or thiophanate-methyl	For powdery mildew, sulfur provides good control.

Peaches, nectarines, plums, apricots (continued)

Spray period	Pest/Disease	Material	Comments
PETAL-FALL SPRAY			
<p>Apply when most of blossom petals have fallen.</p> 	oriental fruit moth plum curculio 	carbaryl or malathion or esfenvalerate or methoxychlor or permethrin	Adult oriental fruit moth begin emerging in mid-April. First generation larva enter at a leaf axil near the tip of a shoot and bores down the central core for several inches, causing the terminal to wilt or "flag." Surface feeding by overwintering adult plum curculio can scar or misshape the fruit by harvest, while feeding by the larvae causes premature fruit drop. Use permethrin on peaches only.
	plant bugs stink bugs 	carbaryl or malathion or endosulfan or esfenvalerate or permethrin	Feeding on small fruit by plant bugs and stink bugs causes the fruit to fall or become scarred and malformed (cat-facing) as they grow. Populations of plant bugs are worst where weed control is poorest. Keep weeds mowed regularly. For endosulfan, do not make more than 2 applications per year. Use permethrin on peaches only.
	<i>Coryneum blight</i>	chlorothalonil	Apply 1–2 weeks after petal fall or at shuck-split.
	brown rot, scab	chlorothalonil or captan or myclobutanil or sulfur or thiophanate-methyl	Make one additional application for scab at shuck-split.
SHUCK-SPLIT SPRAY			
<p>Apply about 10 days after petal-fall spray.</p> 	brown rot scab	captan or myclobutanil or sulfur or thiophanate-methyl	Observe intervals between last application and harvest.
	mites	summer oil or insecticidal soap or pyrethrins and rotenone	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl, or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40° F and below 90° F. For insecticidal soap repeat application 3-4 days later. For pyrethrin and rotenone premix, repeat application every 5-10 days or as needed, do not apply within 1 day of harvest.
	plum curculio oriental fruit moth 	esfenvalerate or malathion or carbaryl or methoxychlor or permethrin	See comments in "petal-fall spray" section.
	plant bugs stink bugs 	carbaryl or malathion or endosulfan or esfenvalerate or permethrin	See comments in "petal-fall spray" section.
	powdery mildew	myclobutanil or sulfur or thiophanate-methyl	
FIRST AND SECOND COVER SPRAYS			
<p>Apply 10 days after shuck spray and again 10 days later.</p>	plum curculio oriental fruit moth 	carbaryl or malathion or esfenvalerate or methoxychlor or permethrin	See comments in "petal-fall spray" section.
	plant bugs stink bugs 	carbaryl or malathion or esfenvalerate or permethrin	See comments in "petal-fall spray" section.



Peaches, nectarines, plums, apricots (continued)

Spray period	Pest/Disease	Material	Comments
FIRST AND SECOND COVER SPRAYS — CONTINUED	mites	summer oil or insecticidal soap or pyrethrins & rotenone	See comments in “shuck-split” section.
	lesser peachtree borer	carbaryl or endosulfan or esfenvalerate or permethrin	Adult moths typically begin to emerge in mid-May (mid-Missouri); apply weekly sprays during moth flight (through June). Larvae can become established only in damaged tissue (pruning wounds, cankered areas, sun-scalded bark, etc.). Once established, the larvae feed on growing bark and may enlarge the damaged area, often girdling the limb Direct sprays from ground level up the trunk and including the main scaffold limbs, wetting the bark thoroughly. For endosulfan, do not make more than 2 applications per year, and do not apply within 30 days of harvest.
	brown rot scab	captan or myclobutanil or sulfur or thiophanate-methyl	
SUMMER COVER SPRAYS			
Apply at 10- to 14-day intervals.	oriental fruit moth 	carbaryl or malathion or esfenvalerate or permethrin	Later-generation oriental fruit moth larvae may enter the fruit near the stem end and make feeding burrows that often extend to the pit.
	mites	summer oil or insecticidal soap or pyrethrins & rotenone	See comments in “shuck-split” section.
	powdery mildew	sulfur	See Table 2 for days between last application and harvest.
	aphids	malathion or insecticidal soap or neem or pyrethrins & rotenone	
	brown rot	captan or myclobutanil or sulfur or thiophanate-methyl	See Table 2 for days between last application and harvest.
PREHARVEST SPRAYS			
Apply 1–2 weeks before harvest.	Green June beetle Japanese beetle	carbaryl or malathion or neem or pyrethrins & rotenone	Adult green June beetles and Japanese beetles can feed on both green and ripening fruit. See Table 2 for days between last application and harvest.
	oriental fruit moth	carbaryl or malathion or esfenvalerate or permethrin	Adult flights of oriental fruit moth may occur at this time. See Table 2 for days between last application and harvest.
	aphids	carbaryl or insecticidal soap or neem or pyrethrins & rotenone	See comments in “summer cover spray” section. See Table 2 for days between last application and harvest.


Cherries

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS (apply before buds break in spring)			
	mites, scale	dormant oil	Oil smothers overwintering eggs of mites and scale.
BLOOM SPRAYS			
Apply when 25% of blossoms are open.			Do not apply insecticides at this time — Save the bees!
	brown rot	chlorothalonil or myclobutanil or thiophanate-methyl	Best control is achieved if an application is also applied at the prebloom or pink (“popcorn”) stage.





Cherries (continued)

Spray period	Pest/Disease	Material	Comments
PETAL-FALL SPRAYS			
Apply when most of blossom petals have fallen.	plum curculio	carbaryl or methoxychlor or esfenvalerate or neem	Neem (azadirachtin) is a botanical insecticide.
	scale	carbaryl or summer oil	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl, or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40° F and below 90° F.
	aphids	carbaryl or malathion or insecticidal soap or pyrethrins & rotenone or neem	For insecticidal soap repeat application 3-4 days later. For pyrethrin and rotenone premix, repeat application every 5-10 days or as needed, do not apply within 1 day of harvest. Neem (azadirachtin) is a botanical insecticide.
SHUCK-SPLIT SPRAY (apply when shucks have split and are falling from expanding fruit)			
	plum curculio	carbaryl or methoxychlor or neem	See comments in "petal fall spray" section.
FIRST COVER SPRAY			
Apply 10 days after shuck-fall.	plum curculio cherry fruit fly 	carbaryl or malathion or esfenvalerate or methoxychlor or neem or pyrethrins & rotenone or spinosad	Maggot-infested fruit by the cherry fruit fly is often shrunken and misshapen, ripens earlier than surrounding fruit, and is unmarketable. <u>Cherry fruit fly only:</u> malathion, pyrethrins and rotenone, and spinosad.
	aphids	carbaryl or malathion or neem or pyrethrins & rotenone or insecticidal soap	See comments in "petal fall spray" section.
	scale	carbaryl or summer oil	See comments in "petal fall spray" section.
	brown rot 	captan or myclobutanil or thiophanate-methyl	
SECOND COVER SPRAY			
Apply 10 days after first cover.	aphids	carbaryl or malathion or neem or pyrethrins & rotenone or insecticidal soap	See comments in "petal fall spray" section.
	plum curculio cherry fruit fly	carbaryl or malathion or esfenvalerate or methoxychlor or neem or pyrethrins & rotenone or spinosad	See comments in "first cover spray" section.
	mites	summer oil or insecticidal soap or pyrethrins and rotenone	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl, or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40° F and below 90° F.
	scale	carbaryl or summer oil	See comments in "petal fall spray" section.


Cherries (continued)

Spray period	Pest/Disease	Material	Comments
	brown rot	captan or myclobutanil or thiophanate-methyl	
ADDITIONAL COVER SPRAYS			
Apply 10 days after second cover, then every 10–14 days.	cherry fruit fly	carbaryl or malathion or methoxychlor or esfenvalerate or neem or pyrethrins & rotenone or spinosad	See comments in “first cover spray” section. See Table 2 for days between last application and harvest.
	aphids	carbaryl or malathion or neem or pyrethrins & rotenone or insecticidal soap	See comments in “petal fall spray” section. See Table 2 for days between last application and harvest.
	mites	summer oil or insecticidal soap or pyrethrins & rotenone	See comments in “second cover spray” section. See Table 2 for days between last application and harvest.
	scale	carbaryl or summer oil	See comments in “petal fall spray” section. See Table 2 for days between last application and harvest.
	cherry leaf spot 	myclobutanil or thiophanate-methyl	Apply as soon as all the fruit have been harvested.




Strawberries

Spray period	Pest/Disease	Material	Comments
PREBLOOM SPRAYS			
Apply when new leaves are expanding and blossom buds are visible.	strawberry clipper 	carbaryl or methoxychlor or permethrin	Stems of developing buds are clipped so that the buds hang down by a thread or fall to the ground. If such damage is present (3 or more clipped buds about every 3 feet), apply insecticide when floral buds first become visible.
	tarnished plant bug 	malathion or endosulfan or permethrin or insecticidal soap	Damaged berries are misshapen, often with the seeds grouped at the tip – referred to as “button berry.” Apply insecticide when buds first become visible, and make a second application just before the first bloom opens. Controlling weeds in and around the planting helps to reduce tarnished plant bug populations.
	spittlebug	carbaryl or malathion or endosulfan or methoxychlor or permethrin	Masses of white, frothy foam (“spittle”) on leaves, petioles and stems. Usually not a problem pest. Early season sprays for tarnished plant bug are usually adequate in controlling spittlebug infestations.
	leaf spot scorch blight	captan	Apply first spray when plants resume growth in the spring, just as soon as the mulch is removed.
BLOOM SPRAYS			
Apply at 7- to 10-day intervals from early bloom through harvest.		Do not apply insecticides during bloom period.	Most varieties are self-fruitful; however, bees are essential for optimum pollination.
	fruit rotting  foliage diseases	captan	Apply at 7–10 day intervals from early bloom through harvest. Captan is also slightly effective against leather rot.
POSTBLOOM THROUGH HARVEST SPRAYS			
Apply at 7- to 10-day intervals from when flowers are gone through harvest.	strawberry leafroller 	carbaryl or malathion or pyrethrins and rotenone	Infestations may develop in spring and early summer, usually 2 to 3 generations each year. Low levels of infestation (less than 20% of strawberry leaflets attacked) do not warrant control. See Table 2 for days between last application and harvest.
	slugs	metaldehyde	Apply to soil or mulch surface around plants. Do not contaminate edible parts or foliage.

Strawberries (continued)

Spray period	Pest/Disease	Material	Comments
POSTBLOOM THROUGH HARVEST SPRAYS – CONTINUED	leafhoppers spittlebugs aphids	carbaryl or malathion or neem or pyrethrins and rotenone or permethrin	Leafhopper feeding damage causes leaves to become yellow between the veins and to curl. Treat only when symptoms become apparent. Several species of aphids attack strawberry, most damage is caused by aphids transmitting viruses from infected to noninfected plants. Such viruses are best managed by using virus-tolerant cultivars or planting certified virus-free plants. See Table 2 for days between last application and harvest.
	tarnished plant bug 	endosulfan or malathion or permethrin or insecticidal soap	See comments in “prebloom spray” section. See Table 2 for days between last application and harvest.
	mites	dicofol or malathion or insecticidal soap	Severe infestations result in slight mottling to a bronze discoloration on upper leaf surface. Silken webbing may be visible on lower leaf surface and between stems. Apply a pesticide when mites first appear, thorough coverage is needed. See Table 2 for days between last application and harvest.
	Japanese beetle	carbaryl or permethrin or pyrethrins and rotenone	See Table 2 for days between last application and harvest.

Raspberries and blackberries

Spray period	Pest/Disease	Material	Comments
DELAYED DORMANT SPRAYS			
Apply when tips of buds show green.	red-necked cane borer 		Characteristic injury is a swelling of the cane, about 3 inches long, with a splitting of the bark. Infested canes are weakened and often die. Remove and burn infested canes in early spring.
	anthracnose 	liquid lime sulfur	Apply to canes when leaves are emerging from buds and before the blossoms open. This spray may damage the new leaves if they are longer than 0.75-inch long.
PREBLOOM SPRAYS			
Apply when blossom buds first appear through when flowers show white.	red-necked cane borer 	pyrethrins and rotenone	See comments in “delayed dormant” section. Adult beetles typically appear when flowers show white. Newly formed swellings can be seen in July and August. Apply insecticide when bloom begins and again 7–14 days later. Direct spray to lower part of the primocane and avoid spraying the blossoms.
	raspberry crown borer	pyrethrins and rotenone	Infested canes become spindly, lack vigor and often break off at ground level. Remove and destroy weakened or infested canes. Drench crown and lower 2 feet of cane with insecticide.
	raspberry fruitworm	carbaryl or esfenvalerate or methoxychlor or neem or pyrethrins & rotenone	Grubs tunnel into the center of the fruit to feed, may cause premature fruit drop. Adult beetles feed on foliage resulting in the leaves being skeletonized. Early developing fruit is more at risk than later developing varieties. Apply insecticide when blossom buds first appear and then again before the blossoms open. Neem (azadirachtin) is a botanical insecticide.
	blackberry psylla	esfenvalerate	Feeding damage causes tightly curled leaf clusters. Such leaf clusters should be removed and destroyed immediately. Apply insecticide when this damage first appears (or first notice of adults).
	tarnished plant bug	malathion or esfenvalerate or permethrin or insecticidal soap	Damaged berries are malformed, and the whitening of a damaged drupelet occurs when mature fruit are attacked. If needed, apply sprays just before the blossoms open and then again when the fruit start to color. Controlling weeds in and around the planting helps to reduce tarnished plant bug populations.
POSTBLOOM THROUGH HARVEST SPRAYS			
	tarnished plant bug	malathion or esfenvalerate or permethrin or insecticidal soap	See comments in “pre-bloom spray” section.

Raspberries and blackberries *(continued)*

Spray period	Pest/Disease	Material	Comments
Apply every 14 days after petal-fall as needed.	Japanese beetle Green June beetle rose chafer sap beetles	carbaryl or methoxychlor or malathion or permethrin or pyrethrins and rotenone	Adult beetles feeding on ripening fruit and foliage. See Table 2 for days between last application and harvest.
	orange rust		In the early spring remove and destroy any infested plants, taking care to remove as much of the root system as possible.

Grapes

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAY			
Apply before buds swell.	anthracnose powdery mildew phomopsis cane and leaf spot	liquid lime sulfur	Apply in early spring before buds begin to swell.
EARLY COVER SPRAYS			
Apply at bud swell, 1-inch shoot growth through first appearance of bloom.	flea beetles	carbaryl or methoxychlor	Larvae and adults can feed on foliage. Most serious damage occurs in the spring when adult beetles feed on newly swollen grape buds. If more than 4% of buds are damaged apply an insecticide.
	climbing cutworm leafrollers aphids	carbaryl or methoxychlor or malathion	These pests may be present anytime between 4- to 10-inch shoot growth and bloom. Scout twice weekly. Apply insecticides only when necessary.
	mites	dicofol or insecticidal soap	For insecticidal soap repeat application 3-4 days later up to day of harvest.
	phomopsis	captan	
	black rot powdery mildew downy mildew	captan or sulfur or mancozeb or myclobutanil	For powdery mildew, use myclobutanil or sulfur. For downy mildew, use captan or mancozeb . Captan and sulfur are only slightly effective against black rot.
BLOOM SPRAY			
Apply when caps begin to fall.	grape phylloxera		Wart-like galls found on leaves and galls on the roots may cause vine death or premature defoliation and retarded shoot growth. Control of the root gall form of grape phylloxera can be achieved by using rootstocks derived from native American grapes. There is no known completely successful chemical control for the root form of grape phylloxera.
	black rot powdery mildew downy mildew	captan or myclobutanil or sulfur	See comments in "early cover spray" section.
POSTBLOOM, SUMMER COVER TO HARVEST SPRAYS			
Apply 7–10 days after bloom. Thereafter, sprays should be applied every 10–14 days.	black rot powdery mildew downy mildew	captan or myclobutanil or sulfur	Sulfur applications may injure plants if temperature exceeds 85° F.
	grape berry moth	carbaryl or methoxychlor or neem	Infestation includes grape berries being webbed together with silken threads and turning dark purple in color. Infested berries may drop from the stems when grapes are about the size of a pea. The larvae tunnel into the berries and feed internally. Several berries in a cluster may be affected. Infested vines should be sprayed at petal fall and again 7–10 days later. See Table 2 for days between last application and harvest.
	mites	dicofol or insecticidal soap	See Table 2 for days between last application and harvest.

Grapes (continued)

Spray period	Pest/Disease	Material	Comments
POSTBLOOM, SUMMER COVER TO HARVEST SPRAYS – CONTINUED	leafhopper leafrollers mealybugs aphids	carbaryl or malathion or pyrethrins & rotenone or insecticidal soap	It is important to monitor for all insect pests after petal fall, and apply insecticide as needed. Refer to product label for specific insects and harvest restrictions. See Table 2 for days between last application and harvest.
	rose chafer Japanese beetle	carbaryl or methoxychlor or malathion	Rose chafer adults feed on blossom buds and leaves. Insecticide treatments should occur after bloom when the first adults are noticed, and if there are on average more than 2 beetles per vine. A second application in June might be needed. Japanese beetle adults feed on the leaves and skeletonize the tissue. If about more than 15% of the leaves are damaged then an insecticide spray is recommended (high beetle populations may require repeated applications). See Table 2 for days between last application and harvest.

Blueberries

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAY			
	phomopsis	lime sulfur	Apply when buds begin to swell.
GREEN TIP SPRAY (apply when leaf buds are showing 1/4-inch green tip)			
	stem blight mummy berry	captan	
PINK BUD STAGE AND 25% BLOOM SPRAY			
	stem blight anthracnose mummy berry	captan	Unless mummy berry or anthracnose is a problem, an intensive disease spray program is usually not necessary.
FULL BLOOM SPRAY			
	stem blight anthracnose mummy berry	captan	See comments in “pink bud” stage.
PETAL-FALL AND COVER SPRAYS			
Apply first cover about 7–10 days after petal fall, about every 10 days thereafter [if needed].	plum curculio	carbaryl or methoxychlor	Plum curculio larvae feed inside berries; infested fruit ripen prematurely and drops to the ground. Infestations of plum curculio are often more abundant when blueberries are near pome and stone fruits. Apply insecticides at petal fall and 10 days later.
	cherry and cranberry fruitworms scale	carbaryl or methoxychlor or permethrin or pyrethrins & rotenone	Insect pests of blueberry are rare in much of the region; scout before applying insecticides. Unneeded applications of insecticides can create problems where none existed. See Table 2 for days between last application and harvest.
	Japanese beetle	carbaryl or malathion or permethrin or pyrethrins & rotenone	See Table 2 for days between last application and harvest.
	stem blight anthracnose mummy berry	captan	See comments in “pink bud” stage.

Gooseberries and currants

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAY (needed on currants only, apply before new growth starts)			
	scale	dormant or summer oil	
	leaf spots	sulfur	Apply as leaves appear and unfold, repeat application at 10 day intervals up to day of harvest.
COVER SPRAYS (apply 10–12 days after leaves appear and start unfolding)			
	aphids currant worm	malathion or pyrethrins and rotenone	Malathion may be applied up to day of harvest. For pyrethrin and rotenone premix, repeat application every 5-10 days or as needed, do not apply within 1 day of harvest.
	leaf spots	sulfur	See comments in “dormant” stage.

(Continued from page 1)

Cultivar selection

Choose a cultivar with care. Consider adaptability to Missouri soils, climate and intended use. Remember, the cultivar planted may often determine the amounts of pesticides needed to produce a crop. For example, Jonathan apples are an eating favorite but must be sprayed to prevent mildew, scab, fire blight and rust diseases. On the other hand, several recently developed disease-resistant varieties have a flavor similar to Jonathan and have the advantage of requiring fewer fungicide sprays. Differences in cultivar susceptibility to diseases exist within each fruit crop. All cultivars must be treated for certain insect pests.

The following MU publications can help you select the best fruit crop varieties for your situation: G6021, *Home Fruit Production: Apples*; G6026, *Disease-Resistant Apple Cultivars*; G6085, *Home Fruit Production: Grape Varieties and Culture*. These publications are available at your local University of Missouri Extension center.

Application equipment

In most situations, apply a fine spray to all parts of the plant until some of the spray liquid runs off. For most brambles, grapes, strawberries and small fruit trees, the conventional pump garden sprayer is adequate. For larger plantings, you may prefer a motorized sprayer.

Whatever type of sprayer you decide to use, rinse it thoroughly and allow it to dry after each use. Many pesticides are corrosive. During a single season, corrosive action can ruin many types of equipment. In addition, pesticide residues remaining in the tank after one spraying may break down or interact with the materials used in the next spraying in ways that can damage plants.

How much pesticide?

Too often, home fruit growers think that if a small amount will control the pest for one week, then twice that amount will give twice as much control. This is a dangerous assumption and can put both the applicator and the plants in unnecessarily dangerous situations. Recommended rates are based on the amounts needed for control. (See Table 3.) Applications that exceed recommended rates contribute needlessly to environmental contamination without increasing control. Repeated applications at 7-, 10- or 14-day intervals (i.e., cover sprays) generally are required to protect growth developed since the last spray, or to replace spray residues that are no longer effective because of weathering and chemical breakdown.

Pesticide safety

Pesticides are poisonous to people and animals. Handle with care! Read the label! The label is the

most important piece of information you will find on the proper use of the material and its hazards. Follow these precautions with all pesticides used:

1. **Read the label!** Be aware of the toxicity of the material you are using and wear appropriate protective clothing.
2. **Observe any days to harvest or re-entry precautions.**
3. **Store pesticides only in their original labeled containers.** Keep all pesticides and utensils used to measure them in a locked storage area out of reach of children and pets.
4. **Wear rubber gloves and protective eye wear when measuring chemicals, preparing spray mixtures and during the application of pesticides.**
5. **Accurately measure the amount to be used each time.** Guessing can be hazardous and expensive.
6. **Do not prepare more spray mixture than is required for the job.** Do not attempt to store unused mixtures for later use.
7. **Spray small amounts of excess spray mixture onto the fruit tree(s) being treated.** Rinse water from the sprayer away from food plants, water supplies and children's play areas.
8. **Do not attempt to reuse any pesticide container.** Rinse cans and bottles (add the rinse to the spray tank); then dispose of them by delivering containers to an approved disposal site.
9. **Do not purchase larger quantities of pesticide than you expect to use in a single season.**
10. **If a pesticide concentrate from a bag, can or bottle is spilled on you or others, wash it off immediately.** Change clothing if it becomes contaminated.
11. **Save the bees.** Bees are often very sensitive to pesticides. Avoid applying insecticides or miticides during the bloom period when bees may be pollinating flowers.

See MU publication G1917, *Personal Protective Equipment for Working with Pesticides*, for more information.

Acknowledgment: We appreciate the assistance of John Hartman, Extension Plant Pathologist, University of Kentucky, who provided the plant disease recommendations.

This publication contains pesticide recommendations subject to change at any time. Before purchasing any materials, make sure they are still approved for recommended use.

Table 2. Pesticides.

Pesticides in this publication are listed by common name. Brand-named products usually available in Missouri are listed in this chart. Undoubtedly, other brand names are available. No discrimination is intended, and no endorsement is implied. **Consult the labels for appropriate rates.**

Common name	Brand name	Days between last application and date of harvest.
INSECTICIDES		
carbaryl	Bonide® Fruit Tree Spray Dragon® Easy Garden Liquid Concentrate Ferti-lome® Liquid Carbaryl Garden Spray GardenTech™ Sevin Concentrate Gordon's® Liquid Dura-Spray® Carbaryl	3 – apple, pear, cherry, peaches, plums, apricots, nectarines 7 – strawberries, grapes, brambles, dewberries, blueberries
dicofol	Hi-Yield® Kelthane Spray	2 – strawberries 7 – grapes
oil (dormant and summer)	Bonide® All Seasons Spray Oil Dragon® Horticultural Spray Oil Ferti-lome® Dormant & Summer Oil Spray Gordon's® Dormant Oil Spray Ortho® Volck Oil Spray	Can be applied up to day of harvest.
endosulfan	Dragon® Thiodan® Insect Spray Hi-Yield® Thiodan Insect Spray	4 – strawberry 7 – plums 21 – apple, cherry 30 – peaches, apricots
esfenvalerate	Ortho® Bug-B-Gon Multi-Purpose Insect Killer	14 – peaches, apricot, cherries, plums 21 – apple, brambles, gooseberries, elderberries 28 – pear
imidacloprid	Bayer Advanced Garden™ Tree & Shrub Insect Control	Applied as a drench around tree trunk. Do not make more than one application per year.
insecticidal soap	Bonide® Insect Killing Soap Concern® Insect Killing Soap Safer® Insecticidal Soap	Can be applied up to day of harvest.
malathion	Bonide® Malathion Ferti-lome® Liquid Fruit Tree Spray Gordon's® Liquid Fruit Tree Spray Hi-Yield® 55% Malathion Spray Ortho® Malathion Plus Spectracide® Malathion Insect Spray	0 – bramble, blueberries, boysenberries, dewberries, loganberries 1 – pear 3 – apple, cherry, strawberry, grapes 7 – peaches, apricots
methoxychlor	Dragon® Methoxychlor Insect Spray	3 – bramble, strawberry, blueberry 7 – apple, cherry, pear, plum 14 – grape 21 – peaches, apricots
metaldehyde	Ferti-lome® Snail & Slug Killer Pellets Ortho® Bug-Geta® Plus Snail, Slug Killer	Apply to the soil and not directly on plants. Do not apply to edible parts or foliage.
neem (azadirachtin)	Bonide® Bon-Neem™ Insecticidal Soap Gordon's® Garden Guard® Liquid Insecticide	Can be applied up to day of harvest.
permethrin	Bonide® Vegetable, Fruit & Flower Bonide® Total Pest Control Bayer Advanced™ Complete Insect Dust	Apple – do not apply after petal fall. 7 – peaches 14 – pear, strawberries, raspberries, blueberries
pyrethrins and rotenone	Bonide® Liquid Rotenone-Pyrethrins Spray Dragon® Rotenone Pyrethrin Insect Spray Spectracide® Bug Stop® For Gardens	1 – all fruits and berries listed
spinosad	Ferti-lome® Borer, Bagworm, Leafminer & Tent Caterpillar Spray Monterey Garden Insect Spray	7 – apple, cherry, plum 14 – peaches, apricots
FUNGICIDES		
Bordeaux mixture	Gordon's® Bordeaux Mixture	See label for details.
captan	Hi-Yield® Captan Fungicide 50% WP Dragon® Captan Wettable Powder Bonide® Captan 50% WP Ferti-lome® Fruit Tree Spray Dragon® Fruit Tree Spray Gordon's® Liquid Fruit Tree Spray	Can be applied up to day of harvest.

Common name	Brand name	Days between last application and date of harvest.
chlorothalonil	Ortho® Garden Disease Control Dragon® Daconil 2787® Plant Disease Control GardenTech™ Daconil Gordon's® Multipurpose Fungicide Bonide® Fung-onil Multipurpose Fungicide	Do not apply between fruit formation and harvest – see label for details.
lime-sulfur	Dragon® Lime Sulfur Solution Bonide® Lime Sulfur Spray	See label for details.
mancozeb	Bonide® Mancozeb Flowable	66 – grapes
myclobutanil	Spectracide® Immunox®	14 – apples, grapes 7 – peaches, apricots, plums, nectarines
sulfur	Bonide® Sulfur Plant Fungicide	Can be applied up to day of harvest.
streptomycin	Ferti-lome® Fire Blight Spray Bonide® Fire Blight Spray	Do not apply when fruit is visible.
thiophanate-methyl	Cleary's 3336 Ferti-lome® Halt™ Systemic Spray	Can be applied up to day of harvest.

For further information

University of Missouri Extension Publications
1-800-292-0969

G1917 *Personal Protective Equipment for Working with Pesticides*
G6020 *Fire Blight*
G6021 *Home Fruit Production: Apples*
G6026 *Disease-Resistant Apple Cultivars*
G6085 *Home Fruit Production: Grape Culture*

Table 3. Dilution table for spray materials.

Powders						
Water quantity	Powder quantity					
100 gal	0.5 lb	1 lb	2 lb	3 lb	4 lb	5 lb
5 gal	5 t	3 T	8 T	10 T	13 T	15 T
3 gal	1 T	2 T	4 T	6 T	8 T	10 T
1 gal	1 t	2 t	4 t	2 T	8 t	3 T
Liquids						
Water quantity	Liquid quantity					
100 gal	0.5 pt	1 pt	2 pt	3 pt	4 pt	5 pt
5 gal	1 T	1 fl. oz.	2 fl. oz.	2.5 fl. oz.	3 fl. oz.	4 fl. oz.
1 gal	0.5 t	1 t	2 t	3 t	4 t	5 t

EXAMPLE: If label calls for 1 pound of spray material per 100 gallons of water, you would need 2 teaspoons of material for a 1-gallon sprayer.

Simple measuring table

- | | |
|---|-----------------------|
| 3 teaspoons = 1 tablespoon | T = tablespoon |
| 2 tablespoons = 1 fluid ounce | t = teaspoon |
| 4 tablespoons = 12 teaspoons = 1/4 cup = 2 fluid ounces | oz. = ounce |
| 1 cup = 16 tablespoons = 8 fluid ounces | pt. = pint |
| 2 cups = 32 tablespoons = 1 pint | fl. oz. = fluid ounce |
| 2 pints = 64 tablespoons = 1 quart | |
| 4 quarts = 1 gallon | |
| 1 ounce = approximately 3 tablespoons dry weight | |

Missouri Poison Control Hotline
1-800-392-9111

All Poison Control Centers are coordinated through Cardinal Glennon Memorial Hospital in St. Louis. This facility has a 24-hour Poison Control Hotline staffed by professionals. The Center will refer you to your closest Poison Control Hospital for treatment.

In case of accidental poisoning involving a pesticide, follow the first aid directions printed on the label of the container and consult your physician immediately. Additional information concerning treatment and course of action can be obtained from your nearest poison control center.